Large and Persistent Reduction in Amazon Forest Carbon Stocks from Fire & Logging

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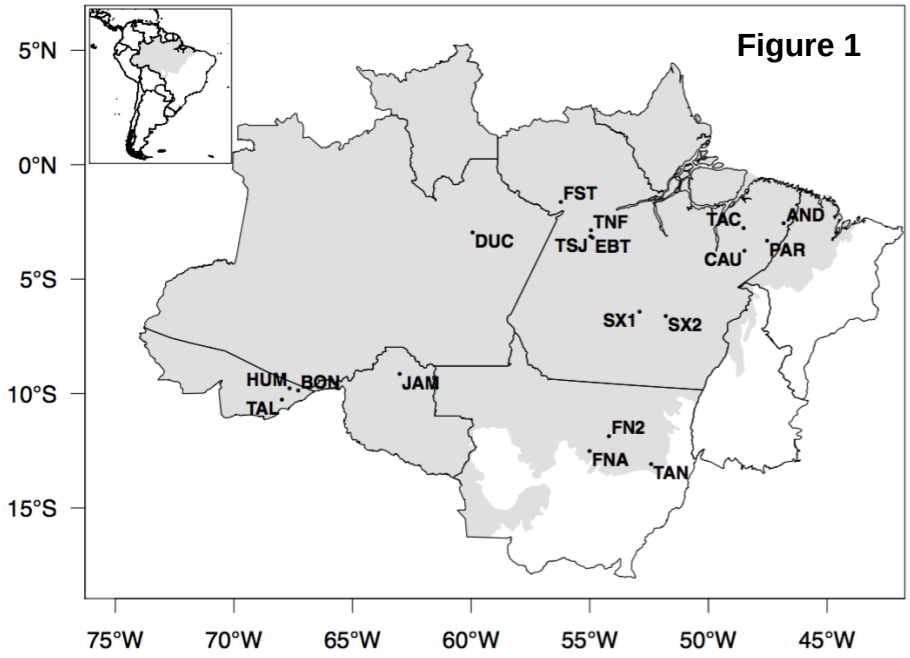

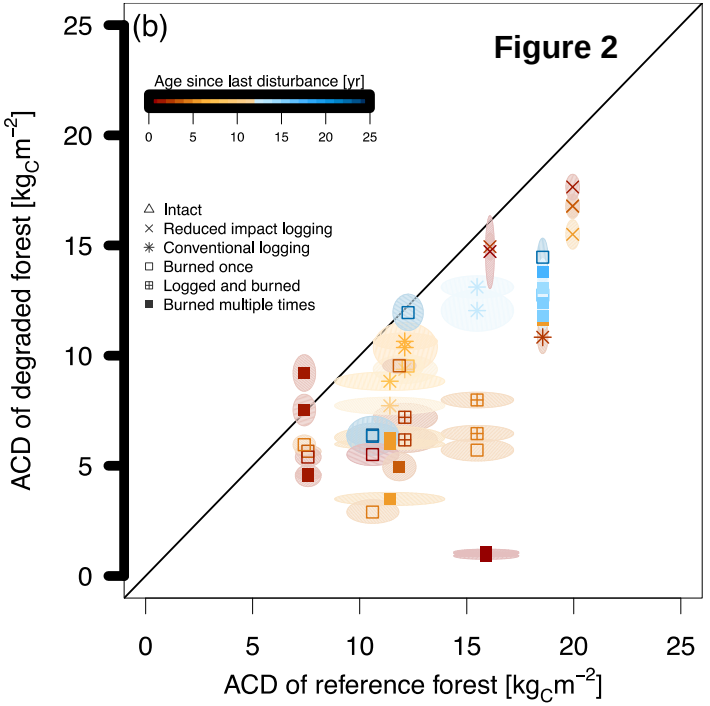

In the largest study of biomass in the Brazilian Amazon to date, carbon stocks in intact and degraded forests were estimated using high-density airborne lidar data and inventory plots for 52 forest sites (Figure 1). Forest degradation resulted in large and persistent differences in aboveground carbon density (ACD) between intact and degraded forests, even in forests with 20+ years of regrowth following logging or fire (Figure 2). Carbon stock reductions were larger for burned forests than logged forests, especially for forests burned multiple times. Airborne lidar captured heterogeneity in degraded forest carbon stocks not identified by inventory plots or first-generation satellite biomass products—critical insights for efforts to Reduce Emissions from Deforestation and Forest Degradation (REDD+).

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Reference:

Longo M., M. Keller, M.N. dos-Santos, V. Leitold, E.R. Pinagé, A. Baccini, S. Saatchi, E.M. Nogueira, M. Batistella, and D. Morton (2016). Aboveground biomass variability across intact and degraded forests in the Brazilian Amazon, Global Biogeochemical Cycles, 30, doi:10.1002/2016GB005465.

Data Sources:

This study combined high-density airborne lidar and forest inventory data from the Sustainable Landscapes project (all data online: https://www.paisagenslidar.cnptia.embrapa.br/webgis/). Estimated aboveground biomass from airborne lidar data was compared to first-generation biomass products based on data from NASA's ICESat-GLAS lidar and MODIS imagery (Saatchi et al., 2011; Baccini et al., 2012). Aggregating data to satellite resolution (0.5 – 1 km^2), airborne lidar captured fine-scale spatial heterogeneity in degraded forest carbon stocks not identified by inventory plots or first-generation satellite biomass products.

Technical Description of Figures:

Figure 1: This map highlights study locations across the Brazilian Amazon, including frontier forest regions with a mixture of intact (old-growth) and degraded forests. In total, 52 sites were used for lidar-biomass model development and analysis.

Figure 2: International efforts to Reduce Emissions from Deforestation and forest Degradation (REDD+) have been hindered by a lack of information on the carbon consequences of forest degradation from logging and fire. In this study, we generated regional estimates of the difference in aboveground carbon density (ACD) between intact and degraded forest types. All points lie below the 1:1 line between intact and degraded forest carbon stocks, consistent with large and persistent differences in ACD from reduced impact (11%) and conventional logging (38%) and fire. Fire carbon losses varied as a function of fire frequency, with increasing differences for forests burned 1x: 37%, 2-3x: 57%, and 5x (93%).

Scientific significance, societal relevance, and relationships to future missions: This is the largest study of biomass variability in the Brazilian Amazon to date, with high-density airborne lidar data (18,000 ha) and 359 coincident inventory plots. The results highlight important gradients in Amazon forest biomass that are not captured by current satellite-based estimates of forest carbon stocks. Large and persistent differences in aboveground carbon stocks in degraded forests highlights the critical need to account for carbon emissions from forest degradation under REDD+ and address drivers of degradation, not only deforestation, to achieve climate mitigation goals from tropical forest conservation.